Suffolk Mill Turbine Exhibit

Lowell National Historical Park
National Park Service
U.S. Department of the Interior

Tremont and Suffolk Mills, circa 1896 Lowell NHP

The Suffolk Mills survive today as a reminder of Lowell's once great cotton textile industry. The Suffolk Mill Turbine Exhibit tells the story of how water provided power for the mills, about the changes brought about in waterpower technology, and of Lowell's world-famous engineers whose turbine designs are still used today.

MILLS AND WATERPOWER

The Lowell mills were built on the Merrimack River at a stretch of rapids known as Pawtucket Falls. This site had been selected to take advantage of the 32-foot fall of water on the river, which would provide enormous waterpower potential for the mass production of cotton cloth. The mill owners built the largest power canal system in the world, channeling water from the river to provide the mills with waterpower. In time, the area would become one of the largest industrial centers in the world.

SUFFOLK MILLS

The Suffolk Manufacturing Company was incorporated in 1831 for the purpose of producing cotton cloth. The Suffolk Mills and Tremont Mills were built at the same time in mirror fashion on opposites sides of the Western Canal. The canal supplied waterpower to both mills. In 1871, these two companies merged operations to become one company: the Tremont and Suffolk Manufacturing Company.

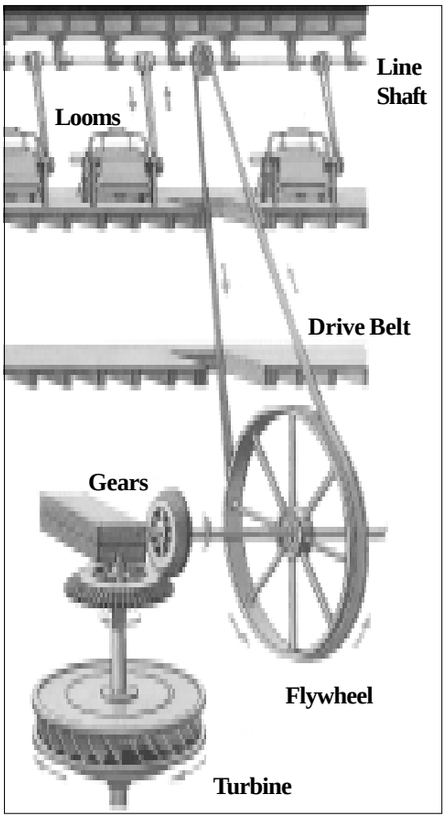
During its nearly one hundred years of operation, the appearance of the Suffolk Mills changed drastically as older buildings were torn down and were replaced with newer ones. The most dramatic changes came during the Civil War. Due to the wartime shortages of cotton, and the opportunity for large profit, the mill owners sold off the company's supply of cotton. The owners used this slow period to tear down the original mill buildings and construct new ones which would be more efficient and profitable. Today, the only surviving building of the original 1830s construction is the countinghouse, which served as the office of the mill agent.

A 19th century mechanic
American Textile History Museum

BELTS AND PULLEYS

To provide power for the mill's machinery, water from the Western Canal passed through a large tunnel or tube, called a penstock, and fell onto a large waterwheel mounted in the basement of the mill. The weight of the falling water turned the wheel, converting the potential energy (stored energy) of falling water into kinetic energy (working, or moving energy). To transfer the power from the waterwheel to the textile machines, the earliest

National Park Service
Lowell National Historical Park
67 Kirk Street
Lowell, MA 01852
978-970-5000
(TDD 978-970-5002)
http://www.nps.gov/lowe



Waterpower transmission, from turbine to loom - Lowell NHP

mills used a network of rotating gears and shafting. This method tended to be slow, noisy, and jarring, with frequent breakdown periods. In 1828, Lowell master mechanic Paul Moody devised a leather belt and pulley system. Using a drive pulley or flywheel to transfer power from a main shaft to the smaller line shafts, power was transferred to the machines. The use of belts and pulleys allowed for a smoother and more efficient transfer of power with fewer breakdown periods. Soon, drive pulleys and leather belting became a standard in mills throughout the United States.

TURBINES

By the late 1830s, the mills in Lowell had utilized most of the available waterpower. A more efficient way of harnessing waterpower was needed. Lowell engineers Uriah Boyden and James B. Francis had begun experimenting with a new kind of waterwheel that had recently come to America from France, known as a turbine. While the original Lowell waterwheels, known as breastwheels, turned when water poured onto them and filled their buckets, turbines turned when water passed directly through them. Turbines proved to be extremely efficient, harnessing 20% more power from falling water than breastwheels. The increased efficiency allowed Lowell's industry to expand.

Beginning in 1853, the Suffolk Mills began installing turbines designed by Uriah Boyden in the wheel pits of a new picker house. This site is now occupied by Mill Building #6, which uses the same wheel pits and houses Lowell National Historical Park's Turbine Exhibit. With the installation of these new turbines, the power source for the Suffolk Mills shifted from the Western Canal to the newly built Northern Canal.

Chief Engineer James B. Francis researched and developed more efficient turbines in this period. Driven by a desire for perfection and obsessed with efficiency in waterpower, Francis published the results of his experiments in *The Lowell Hydraulic Experiments*, in 1855. He became world-renowned for his vast knowledge of waterpower. The turbine he designed, known as the Francis turbine, is still being manufactured and used throughout the world. His turbine design has also been adapted for use in other technologies, such as in jet engines.

James B. Francis
Lowell NHP

NEW POWER SOURCES

By the 1850s, high smokestacks began to appear alongside of the mills in Lowell, signifying the arrival of steam power. The Suffolk Mills had installed its first steam engine by 1860, allowing the mill to expand production without relying on waterpower. By 1875, more steam power was in use by the mills than was waterpower.

By 1897, the Suffolk Mill's four original Boyden turbines had been replaced by newer, more efficient Francis turbines built by the Victor-Standard Company. These were half the size of the Boyden turbines, but were equally as powerful. The smaller size of these new turbines also meant that two could be installed in each wheel pit which had held one Boyden turbine. These turbines supplied enough power to operate at least eleven mill floors of textile machines. These turbines remain in place today.

Today, one restored turbine is used to demonstrate how waterpower was harnessed and transferred to machinery. The turbine uses a 13-foot water drop from the Northern Canal. The water flows through the penstock and drops through the turbine, causing it to spin. The spinning motion is transferred through shafts, gears, belts, and pulleys to a power loom. This loom represents the hundreds of looms that the mill once operated. A park ranger demonstrates the operation of this waterpowered loom during guided tours.

By 1910, Lowell's textile mills had begun to use hydroelectricity. By 1920, the Suffolk Mills had installed several generators for this purpose. These generators were connected to the high speed Victor-Standard turbines, continuing the use of waterpower into the 20th century. One of these generators is on display in the basement of the Suffolk Mills.

The Tremont and Suffolk Manufacturing Company finally closed its doors and sold the facility in 1926. The mill continued to operate under various owners, finally ending its days in the textile industry as the Wannalancit Mill, when it closed in 1981.

Waterpower technology, developed in Lowell by brilliant engineers such as Uriah Boyden and James B. Francis, became the industrial standard in 19th century America. The Suffolk Mill Turbine Exhibit illustrates how this technology was used to power the American Industrial Revolution.